

Debt Covenants and the Macroeconomy: The Interest Coverage Channel

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Introduction

- ▶ Non-residential investment is a key driver of monetary policy response.
 - Natural link: \$6T corporate debt market.
 - Large body of work on transmission through credit limits (“financial accelerator”).
- ▶ Firm credit limits typically modeled as limit on market leverage.
 - But actual covenants in debt contracts quite different from this stylized model.
 - Lian and Ma (2017): importance of earnings based constraints.
 - But many covenants depend on more than earnings, firms often have several at once.
- ▶ **Research question:** how does firm credit limit structure influence macro dynamics?
 - Focus on **Interest Coverage (IC)** covenants that cap ratio of interest payments to earnings.

This Paper

- ▶ **Approach:** combine structural model with firm-level empirical evidence.
- ▶ **Stylized Facts:** Interest Coverage covenants extremely common (seen in 84% of firms in DealScan sample with covenants), maximum ratios appear stable over time.
- ▶ **Main Finding #1:** Interest Coverage covenants amplify interest rate transmission.
 - Much stronger responses of debt, investment, output than under alternative covenant types.
 - Reason: directly shifted by interest rates.
 - Rates \downarrow 100bp \implies extra 6.3% 8Q asset growth in data (4.4% in model).
- ▶ **Main Finding #2:** Combination of interest coverage + other cov. \implies state dependence.
 - Whether interest coverage is tightest covenant determined by interest rate.
 - Stronger transmission when rates are already high (and IC covenants likely to bind).
 - High vs. low rates: \downarrow 100bp \implies extra 4.9% 8Q asset growth in data (1.5% in model).

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Background: Debt Covenants

- ▶ Covenants provide conditions that, if violated by the firm, allow lender to demand immediate repayment.
 - Often set thresholds for financial ratios \implies debt limits.
 - Applies to entire firm's statistics, not limited to individual loan.
 - Violation typically leads to (costly) renegotiation, but for today treat as hard caps.
- ▶ Three main types:
 1. **Interest Coverage (IC):** restrict interest payments \leq fraction θ^{IC} of earnings (EBITDA).
 2. **Debt/Earnings (DE):** restrict stock of debt \leq fraction θ^{DE} of earnings (EBITDA).
 3. **Leverage:** restrict stock of debt \leq fraction θ^{LEV} of firm book value.

Simple Example of Interest Rate Transmission

- ▶ Consider firm with EBITDA \$10M, max ratio of interest payments to EBITDA of 40%.
 - Max interest payment is \$4M.
 - At 10% interest rate, firm can borrow up to $\$4M / 0.1 = \$40M$ without violating.
 - If rates fall to 9%, firm can now borrow $\$4M / 0.09 = \$44.4M$, an increase of 11%
- ▶ This high sensitivity holds even if firm uses only fixed-rate debt.
 - In this case, relevant interest rate is rate on **new** fixed rate debt.
- ▶ If firm already holds floating rate debt, amount of new debt firm can take on without violating even more sensitive.
 - If firm already has \$20M at same floating rate (10%), can borrow addl. \$20M without violating.
 - After fall in rates, old debt only contributes \$1.8M toward interest cap, can borrow $\$2.2M / 0.09 = \$24.4M$, increase of 22%.

Simple Example of Interest Rate Transmission

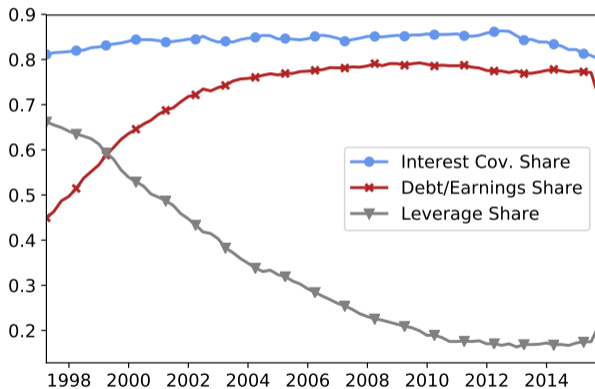
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Covenant Prevalence by Type

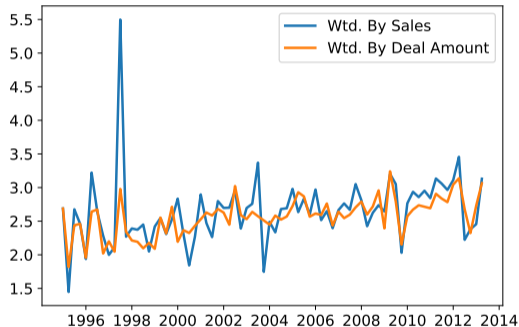
- ▶ Plot: share with each covenant type for firms with at least one DealScan covenant.
- ▶ Share with Interest Coverage high and stable over time.



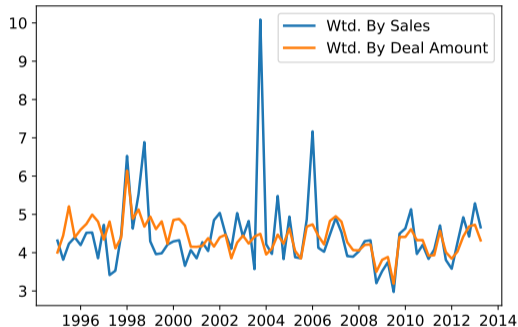
Source: DealScan. Shares are equally weighted among DealScan firms with at least one covenant.

Covenant Ratios Over Time

- Complication: covenant limits are endogenously set. Do lenders dynamically adjust simple covenants to achieve more complex debt policies?



(a) Min Interest Cov. Ratio



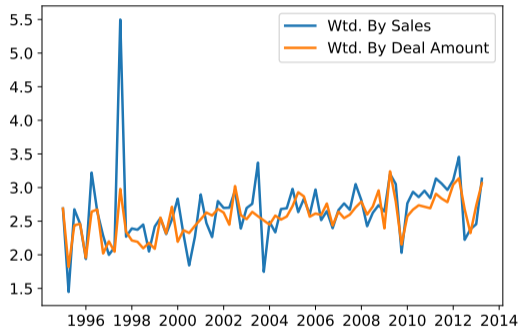
(b) Max Debt/Earnings Ratio

Source: DealScan, Compustat.

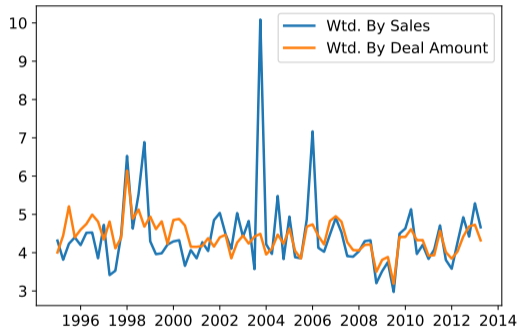
Covenant Ratios Over Time

▶ Below: initial covenant ratios **at origination** in DealScan. Appear noisy but stable over time.

- Note: Min Interest Cov. Ratio = EBITDA / payment.



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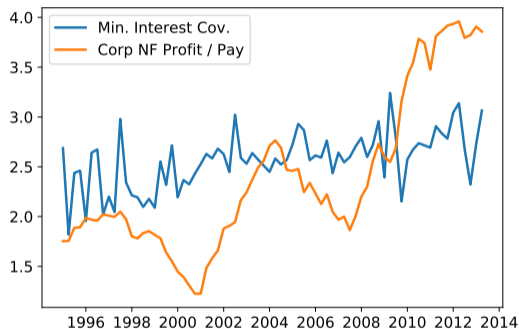


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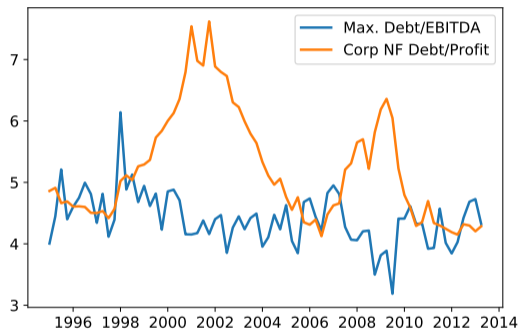
Source: DealScan, Compustat.

Covenant Ratios Over Time

- ▶ Second check: maximum ratios on new loans stable even when underlying aggregate economic ratios move.



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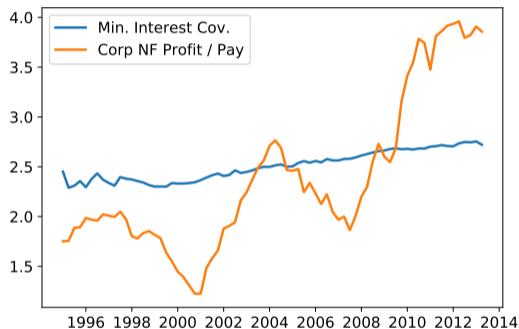


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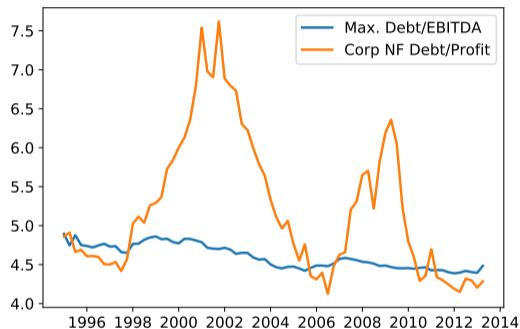
Source: DealScan, Compustat, NIPA, Flow of Funds. Covenant limits are weighted by deal amount. Debt payments assume 600bp spread over 3-Month Treasury. Min. Interest Cov. is the min. allowed Earnings / Interest ratio.

Covenant Ratios Over Time

- ▶ Now look at all **active** covenants. Provide stable constraints even as variables move.



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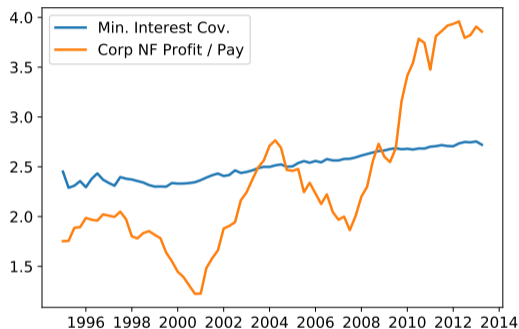


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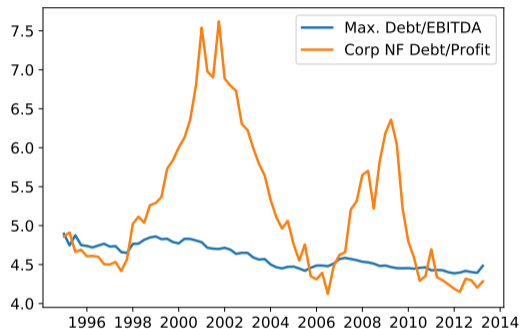
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Covenant Ratios Over Time

- ▶ Takeaway: covenants have structural meaning, reasonable to consider as fixed limits at business cycle frequency.



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Firm Characteristics by Covenant

- ▶ Firms with covenants larger, more levered than firms without covenants/syndicated loans.

	None	IC	DE	Lev	IC + DE	IC + Lev	DE + Lev
Sales	8.56	118.36	125.05	70.08	129.36	82.89	86.52
EBITDA	0.39	13.99	15.42	7.22	16.30	8.43	9.00
Assets	57.33	449.83	490.86	257.44	516.04	300.89	316.89
PPE	5.24	96.72	103.79	56.06	109.22	69.38	70.90
Debt	2.88	138.26	160.90	52.78	173.76	69.74	76.50
ST Debt	0.46	5.48	5.76	3.74	5.92	4.33	4.37
LT Debt	0.77	115.31	137.80	34.71	150.00	50.06	58.09
Cash	7.95	14.80	16.49	12.31	16.13	10.53	11.00
Debt/EBITDA	0.00	8.44	8.97	5.49	9.47	6.56	7.16
Debt/Assets	0.12	0.32	0.33	0.24	0.34	0.27	0.28
Market-to-Book	1.72	1.38	1.40	1.39	1.39	1.34	1.35
<i>N</i>	184,275	69,824	56,782	36,962	51,028	27,506	16,360

Source: Dealscan, Compustat. [▶ Additional Groupings](#)

Firm Characteristics by Covenant

- Firms with IC covenants generally similar to firms with DE covenants. Firms with Leverage covenants a bit smaller.

	None	IC	DE	Lev	IC + DE	IC + Lev	DE + Lev
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Model

Model Overview

▶ Demographics and preferences

- Risk-neutral representative household consumes and provides labor.
- Interest rate variation \implies time varying discount factor:

$$\log \beta_t = (1 - \rho_\beta) \log \bar{\beta} + \rho_\beta \log \beta_{t-1} + \varepsilon_{\beta,t}.$$

- Representative firm owns capital and pays dividends to household.

▶ Productive technology: $f(K_{t-1}, N_t) = Z_t K_{t-1}^\alpha N_t^{1-\alpha}$

▶ Firm capital structure:

- Risk-free floating rate debt at rate r_t , interest is tax deductible (**tax shield**).
- Dividend adjustment costs (**financing frictions**) following Jermann and Quadrini (2012).
- Combined: pathway from debt limits \rightarrow debt \rightarrow investment.

▶ Flexible prices and wages, monetary authority targets (and achieves) constant inflation.

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Representative Firm's Problem

- Rep. firm chooses dividends D_t , labor demand N_t , new debt B_t and the investment rate i_t to maximize

$$V^F(K_{t-1}, B_{t-1}) = \Psi(D_t) + E_t[\Lambda_{t+1} V^F(K_t, B_t)]$$

where concave $\Psi(D_t)$ represents adjustment costs for dividends, Λ_{t+1} is the household SDF, subject to the budget constraint

$$D_t = \underbrace{(1 - \tau)(f(K_{t-1}, N_t) - w_t N_t)}_{\text{after-tax profit}} + \underbrace{\tau \delta K_{t-1}}_{\text{depreciation credit}} - \underbrace{i_t K_{t-1}}_{\text{investment}} \\ - \underbrace{(1 - \tau)r_t \pi_t^{-1} B_{t-1}}_{\text{interest payment}} + \underbrace{(B_t - \pi_t^{-1} B_{t-1})}_{\text{net principal}}$$

and the borrowing constraint (debt covenants).

Covenant Implementations

▶ Denote EBITDA by $X_t = f(K_{t-1}, N_t) - w_t N_t$.

▶ Covenant types:

1. **Interest Coverage:** $\bar{B}_t^{IC} = \frac{\theta^{IC} X_t}{r_t}$.

2. **Debt/Earnings:** $\bar{B}_t^{DE} = \theta^{DE} X_t$.

3. **Leverage:** $\bar{B}_t^{LEV} = \theta^{LEV} BV_{t-1} \simeq \theta^{LEV} K_{t-1}$.

▶ Only interest coverage **directly shifted** by interest rates.

- Highly sensitive, elasticity of \bar{B}^{IC} to rates is ~ 10 .

▶ Overall debt limit is smoothed to allow for e.g., annual financial statistics:

$$B_t \leq \rho \bar{B}_t + (1 - \rho) \pi_t^{-1} B_{t-1}$$

Collateralizability

- ▶ Debt limits are mechanically sensitive to interest rates under IC covenants.
- ▶ What about transmission into real investment? Optimality condition:

$$\underbrace{q_t}_{\text{Tobin's } q} = \underbrace{\Omega_t}_{\text{Value of CFs}} + \underbrace{\mathcal{M}_t E_t \left[(1 + r_t) \frac{\partial \bar{B}_{t+1}}{\partial K_t} \right]}_{\text{Collateral Benefit}}$$

- ▶ Key object is **collateralizability** of investment: $\partial \bar{B}_{t+1} / \partial K_t$:

$$\frac{\partial \bar{B}_t^{IC}}{\partial K_t} = \frac{\theta^{IC} f_{K,t+1}}{r_{t+1}}, \quad \frac{\partial \bar{B}_t^{DE}}{\partial K_t} = \theta^{DE} f_{K,t+1}, \quad \frac{\partial \bar{B}_t^{LEV}}{\partial K_t} = \theta^{LEV}.$$

- ▶ All covenants are collateralizable, but only IC collateralizability varies with interest rate.

Calibration

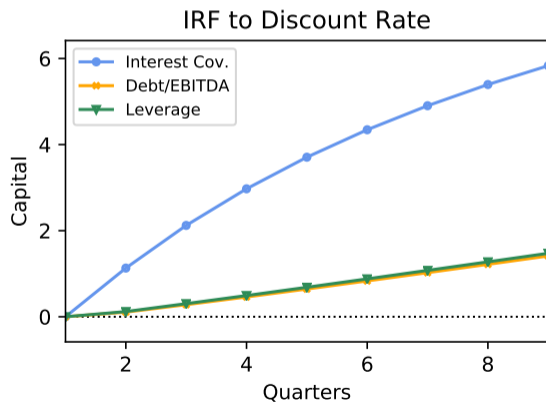
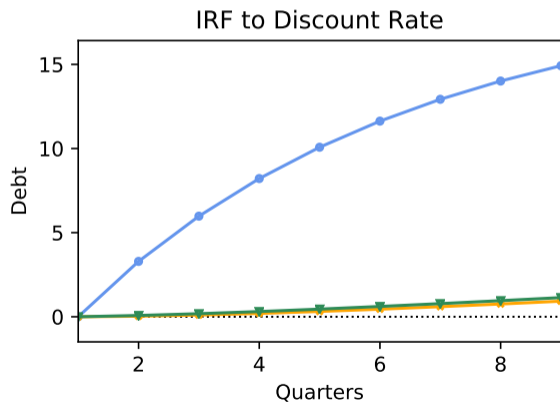
- ▶ For today, no capital adjustment costs, isoelastic (power) dividend smoothing.

Parameter	Name	Value	Internal	Target/Source
Discount factor mean	$\bar{\beta}$	0.986	N	6% real rate
Discount factor persistence	ρ_{β}	0.992	N	Autocorrelation of 3-Mo T-Bill
Labor disutility scale	η	1.072	Y	$N_{SS} = 1$
Tax rate	τ	0.350	N	Corporate tax rate
Inflation rate	$\bar{\pi}$	1.005	N	2% inflation
Capital share	α	0.360	N	Standard
Depreciation	δ	0.025	N	Standard
Dividend cost elasticity	ζ_D	1.000	N	Moderate smoothing
Borrowing limit smoothing	ρ_B	0.250	N	Annualized ratios
Max interest coverage ratio	θ^{IC}	0.108	Y	Book leverage = 1/3 in IC economy
Max debt-to-earnings ratio	θ^{DE}	5.485	Y	Book leverage = 1/3 in DE economy
Max Leverage ratio	θ^{LEV}	0.338	Y	Book leverage = 1/3 in Lev. economy

Results

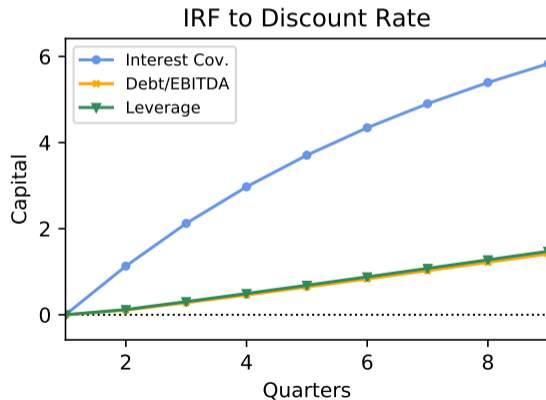
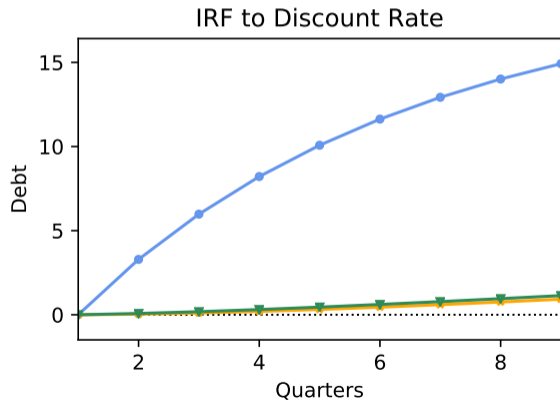
Comparison: Covenant Types

- ▶ **Main Result #1:** Interest Coverage covenants amplify interest rate transmission.
- ▶ Compare linearized IRF to \downarrow 100bp disc. rate shock in economies each with single constraint.



Comparison: Covenant Types

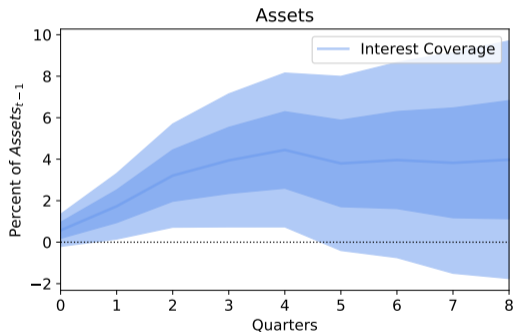
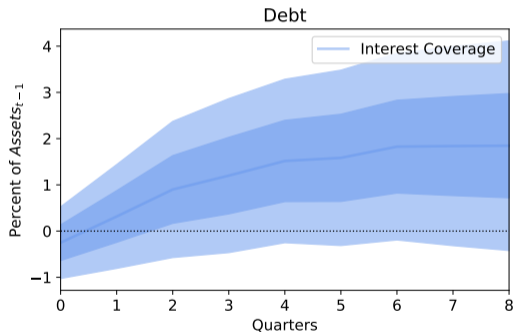
- ▶ IC economy: large relaxation of debt limits \implies capital, EBITDA growth \implies feedback.
- ▶ Additional 8Q growth of debt (14.1%), capital (4.4%), output (4.4%) relative to DE economy.



Empirical Evidence: Covenant Types

- ▶ Regression on merged Compustat (investment, debt) + DealScan (loan covenants) data:

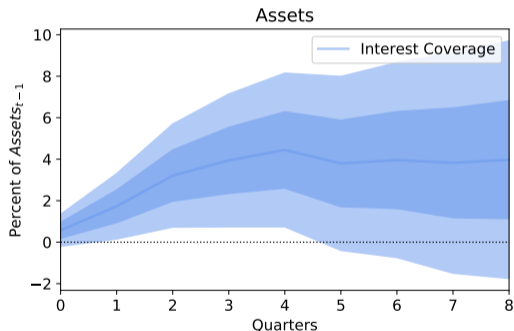
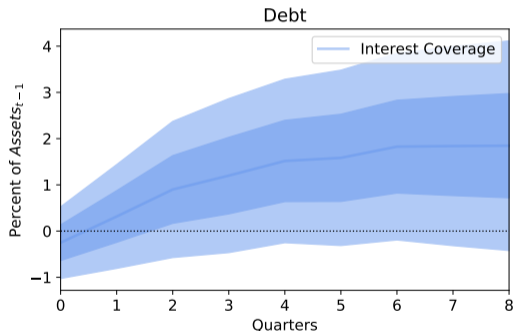
$$y_{i,t+h} = \alpha_i + \phi_{ind,t} + \sum_{COV} \mathbb{I}_{cov,t} \cdot (\beta_{0,cov} + \beta_{1,cov} \Delta r_t) + \gamma' X_{t-1} + \delta' (X_{t-1} \cdot \Delta r_t) + \varepsilon_{i,t}$$



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4. Dark bands indicate 67% confidence bands, while light bands indicate 95% confidence bands. Standard errors are clustered at the firm level. ▶ MP Shocks

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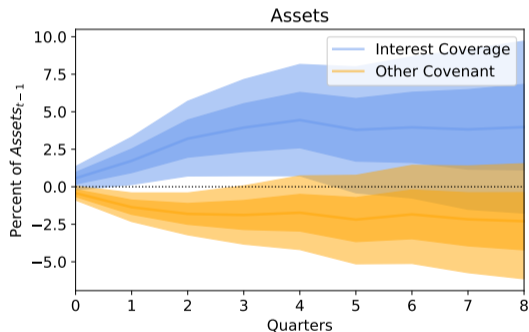
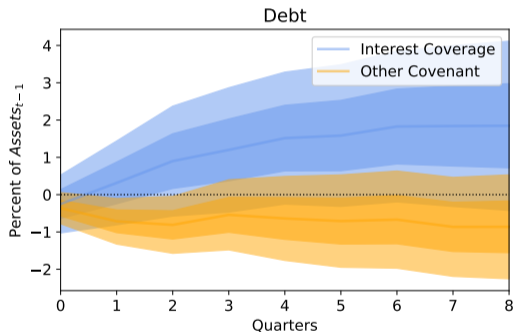
- ▶ Industry-time fixed effects control for endogeneity of interest rate.
- ▶ Larger responses to rates \downarrow 100bp for firms with Interest Coverage covenants.



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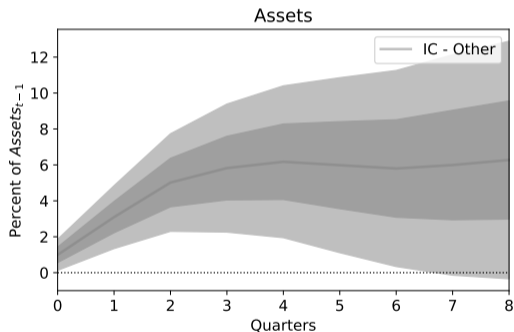
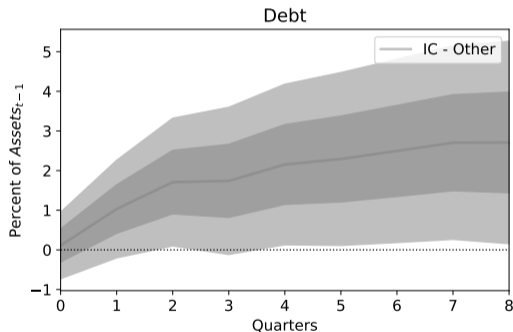
- ▶ Challenge: firms with no covenants differ from IC firms on observables.
- ▶ Better comparison: firms with DE covenants. These show no increased response.



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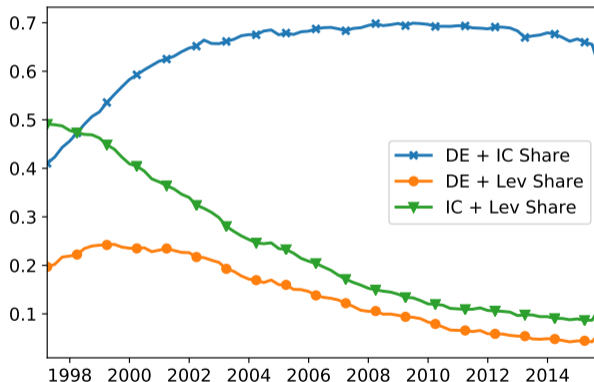
- ▶ Formal comparison: estimate $\beta_{1,IC} - \beta_{1,DE}$.
- ▶ Estimate: higher 8Q debt growth (2.7%), asset growth (6.3%) for IC relative to DE covenant.



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4. Dark bands indicate 67% confidence bands, while light bands indicate 95% confidence bands. Standard errors are clustered at the firm level.

Multiple Covenants

- ▶ Previous analysis considers economies with a single covenant at a time.
- ▶ Data: most firms with any covenants have **both** Interest Coverage + Debt/Earnings.



Source: DealScan. Shares are equally weighted among DealScan firms with at least one covenant.

Implementation: Debt/Earnings + Interest Coverage Covenant

- ▶ Assume common Debt/Earnings limit $\bar{\theta}^{DE}$, but each firm i faces idiosyncratic IC limit:

$$\theta_{i,t}^{IC} = e_{i,t} \bar{\theta}^{IC}, \quad e_{i,t} \stackrel{iid}{\sim} \Gamma_e$$

- ▶ Timing:

- Firm re-draws $e_{i,t}$ each time it takes on new debt.
- Must choose capital before it knows its draw of $e_{i,t}$.

- ▶ Overall debt limit: $\bar{B}_{i,t} = \min(\bar{B}_{i,t}^{IC}, \bar{B}_{i,t}^{DE})$.

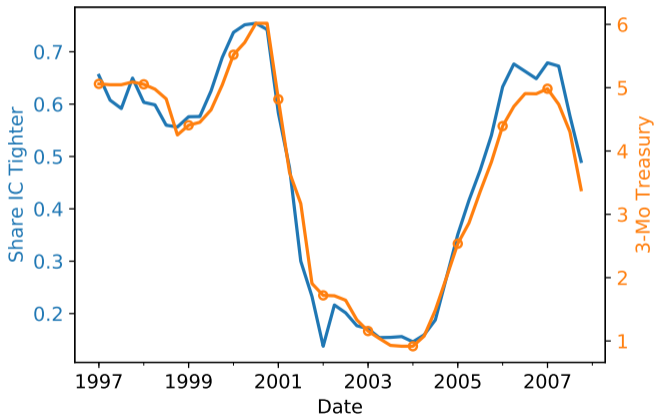
- ▶ Calibrate σ_e to match IQR of $\theta_{i,t}^{DE} / \theta_{i,t}^{IC}$ in DealScan data ($\sigma_e = 0.301$).

- ▶ Calibrate $\bar{\theta}^{IC}, \bar{\theta}^{DE}$ to match that 47% have tighter IC at steady state.

State Dependence

- ▶ Whether Interest Coverage vs. Debt/Earnings is tighter uniquely determined by rates.

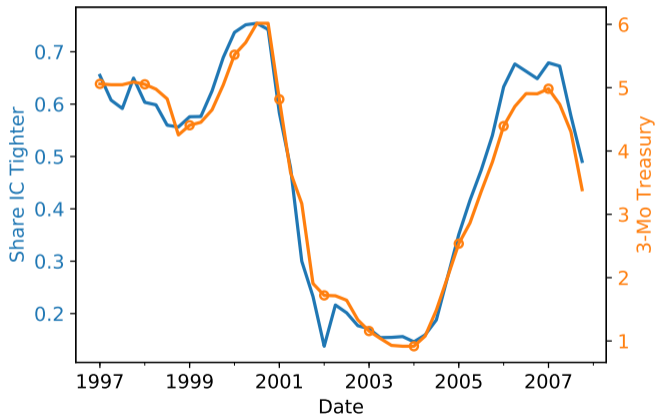
- IC binds $\iff r_t \geq r_{i,t}^* \equiv \theta_{i,t}^{IC} / \bar{\theta}^{DE}$



Source: DealScan, Compustat, equally weighted. Assumed interest rate is 600bp spread over the 3-Month T-Bill.

State Dependence

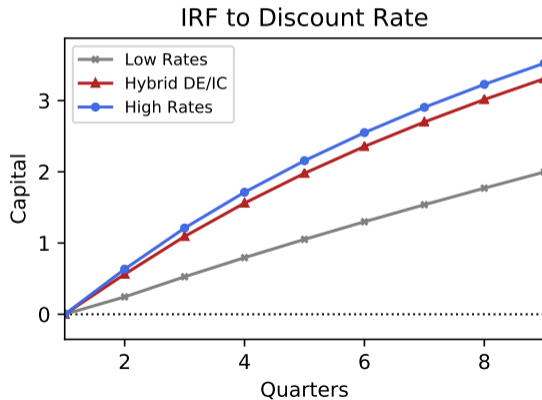
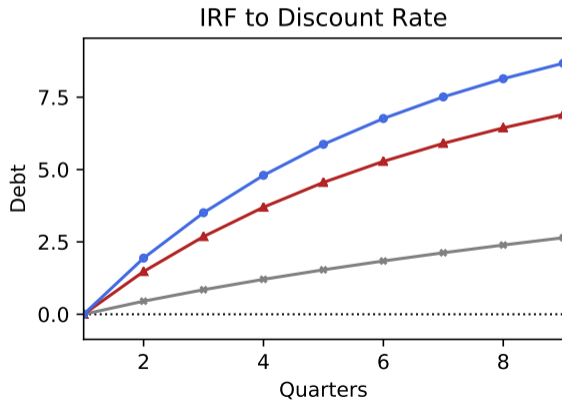
- DealScan data: substantial variation in implied fraction with IC as tighter covenant.



Source: DealScan, Compustat, equally weighted. Assumed interest rate is 600bp spread over the 3-Month T-Bill.

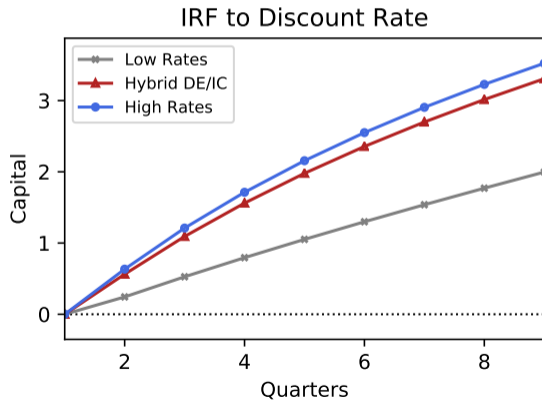
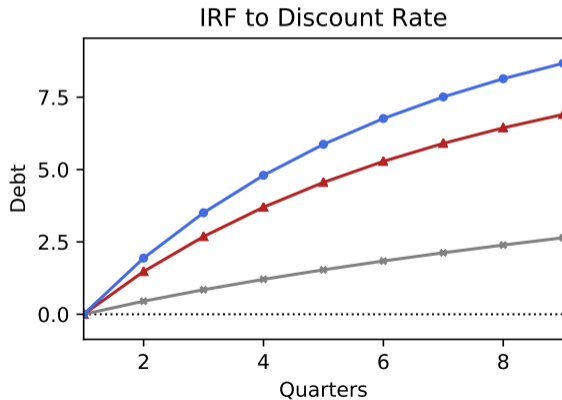
State Dependence: DE + IC Covenants

- ▶ **Main Result #2:** Combining IC + DE covs \implies **state dependent** interest rate transmission.
- ▶ Alternative regimes with SS interest (discount) rate high (+250bp) vs. low (-250bp).



State Dependence: DE + IC Covenants

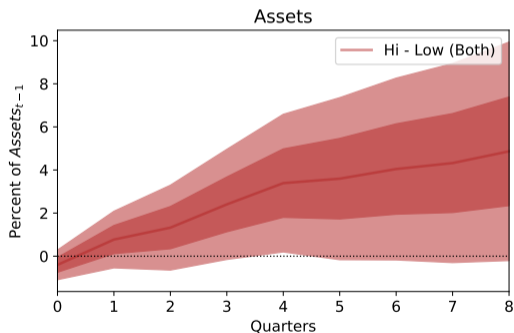
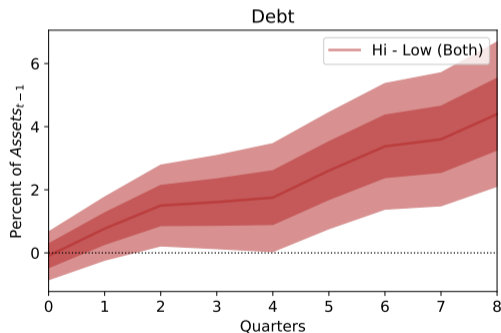
- ▶ Stronger transmission when rates are high (79% IC binds) vs. low (8% IC binds).
- ▶ Additional 8Q growth in debt (6.0%), capital (1.5%) in high vs. low rate regime.



Empirics: State Dependence

- ▶ Augment original regression so coefficients depend on interest rate regime (cutoff = 3.5%):

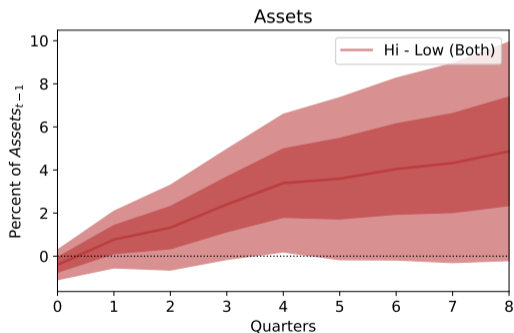
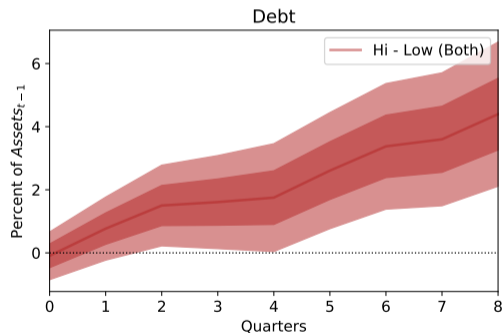
$$y_{i,t+h} = \alpha_i + \phi_{\text{ind},t} + \sum_{s \in \{\text{hi}, \text{low}\}} \mathbb{I}_{s,t} \left\{ \sum_{\text{cov}} \mathbb{I}_{\text{cov},t} \cdot \left(\beta_{0,\text{cov}}^s + \beta_{1,\text{cov}}^s \Delta r_t \right) + \gamma'_s X_{t-1} + \delta'_s (X_{t-1} \cdot \Delta r_t) \right\} + \varepsilon_{i,t}$$



Source: DealScan, Compustat. Dark bands indicate 67% confidence bands, while light bands indicate 95% confidence bands. Standard errors are clustered at the firm level. The sample spans 1997Q1 to 2007Q4.

Empirics: State Dependence

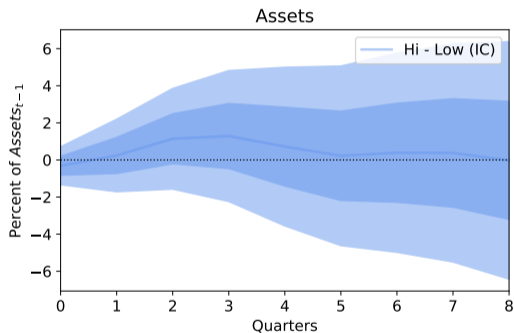
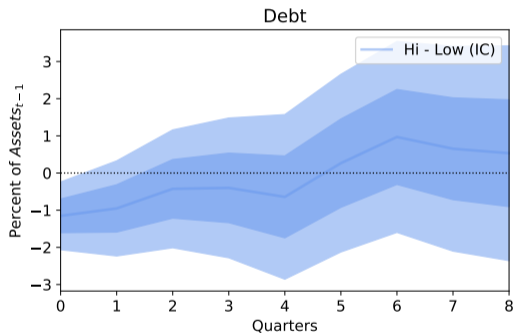
- ▶ Increased 8Q growth in debt (4.4%), assets (4.9%) in high vs. low rate environment.
- ▶ Stronger response in high vs. low rate regime (despite smaller proportional change).



Source: DealScan, Compustat. Dark bands indicate 67% confidence bands, while light bands indicate 95% confidence bands. Standard errors are clustered at the firm level. The sample spans 1997Q1 to 2007Q4.

Empirics: State Dependence

- ▶ No state dependent response for firms with IC covenant only.



Source: DealScan, Compustat. Dark bands indicate 67% confidence bands, while light bands indicate 95% confidence bands. Standard errors are clustered at the firm level. The sample spans 1997Q1 to 2007Q4. [▶ D/E](#) [▶ Diff-in-Diff](#)

Conclusion

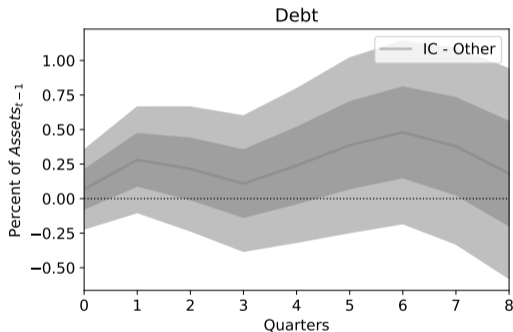
- ▶ Novel model capturing key facts about corporate debt limits.
 - Interest Coverage limits are extremely common, caps stable over time.
 - Typical firm has multiple covenants.

- ▶ Main results:
 - Interest Coverage covenants amplify interest rate transmission.
 - State dependent transmission: stronger when rates are high.
 - Findings supported by firm-level data.

- ▶ Next steps:
 - Improved empirics, breakdowns by firm/debt characteristics.
 - More realistic firm profile, violation risk instead of hard caps.
 - Scraping EDGAR data.

Monetary Policy Shocks

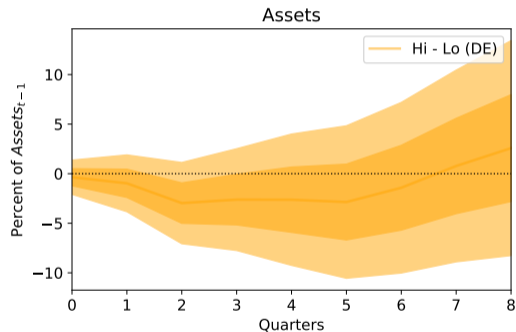
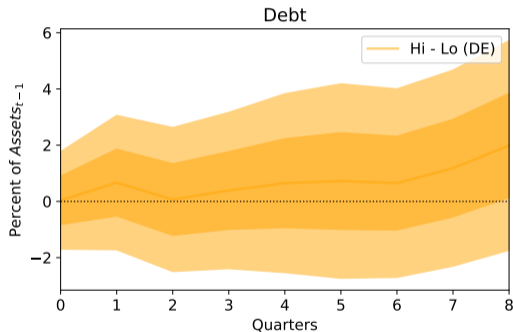
- ▶ Replace Δr_t with identified MP shocks following Gertler and Karadi (2012)



Source: DealScan, Compustat. Dark bands indicate 67% confidence bands, while light bands indicate 95% confidence bands. Standard errors are clustered at the firm level. The sample spans 1997Q1 to 2007Q4. [▶ Back](#)

Empirics: State Dependence

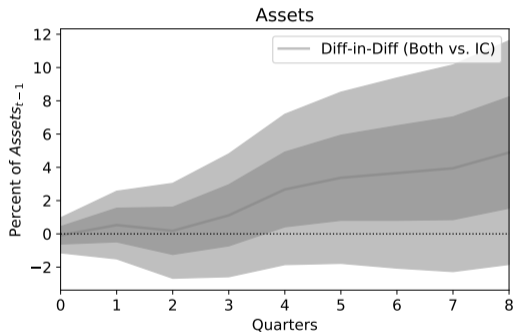
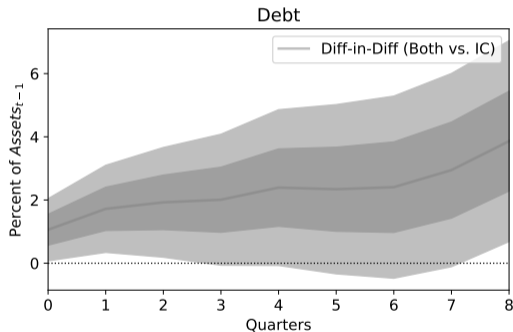
- ▶ No state dependent response for firms with IC covenant only.



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4.

Empirics: State Dependence

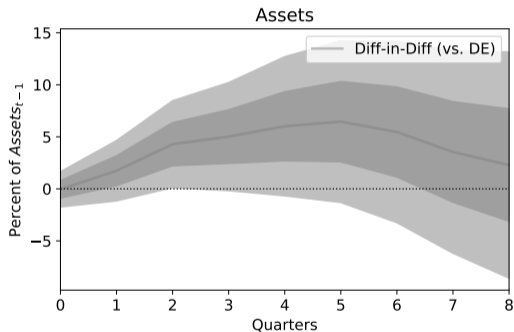
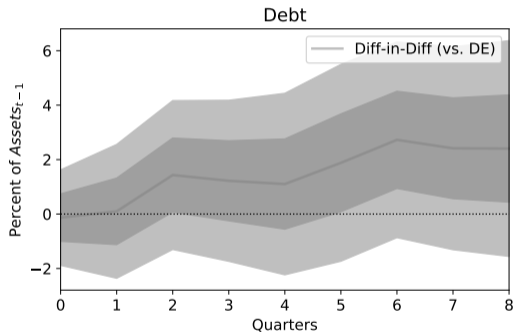
- ▶ Difference in difference (high vs. low, both covenants vs. IC only).



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4. [▶ Back](#)

Empirics: State Dependence

- ▶ Difference in difference (high vs. low, both covenants vs. DE only).



Source: DealScan, Compustat. The sample spans 1997Q1 to 2007Q4. [▶ Back](#)

Representative Household's Problem

- ▶ Rep. household chooses consumption C_t , labor supply N_t and new debt B_t to maximize

$$V^H(B_{t-1}) = u(C_t) - v(N_t) + \beta E_t[V^H(B_t)]$$

subject to the budget constraint

$$C_t = \underbrace{\Psi(D_t)}_{\text{dividends}} + \underbrace{(1 - \tau)w_t N_t}_{\text{labor income}} + \underbrace{r_t \pi_t^{-1} B_{t-1}}_{\text{interest payment}} - \underbrace{(B_t^* - \pi_t^{-1} B_{t-1})}_{\text{net debt issuance}} + \underbrace{T_t^S}_{\text{transfer}}$$

▶ Back

Firm Characteristics by Covenant: Additional Groupings

	None	IC	Non-IC	IC Only	DE Only	Lev Only
Sales	8.56	118.36	53.65	104.88	115.16	33.53
EBITDA	0.39	13.99	4.84	8.10	9.71	2.66
Assets	57.33	449.83	190.61	308.71	361.14	141.53
PPE	5.24	96.72	33.42	78.46	83.81	20.72
Debt	2.88	138.26	25.77	82.36	98.83	12.21
ST Debt	0.46	5.48	3.04	5.90	6.67	2.33
LT Debt	0.77	115.31	12.82	57.77	77.58	5.94
Cash	7.95	14.80	22.11	12.12	24.47	23.18
Debt/EBITDA	0.00	8.44	3.12	7.37	5.35	2.04
Debt/Assets	0.12	0.32	0.18	0.30	0.24	0.16
Market-to-Book	1.72	1.38	1.56	1.36	1.51	1.60
<i>N</i>	184,275	69,824	13,286	5,726	3,830	7,532

Source: Dealscan, Compustat. [▶ Back](#)